

REMARKS

In view of the above amendments and following remarks, reconsideration and further examination are requested.

By the current Amendment, claims 24-30 have been cancelled, claims 31, 33, 34 and 37 have been amended and claims 41-53 have been added.

The instant invention pertains to an electroless-plating liquid for forming a protective film on a surface of an exposed interconnect of a semiconductor device, and a semiconductor device having the protective film on a surface of an exposed interconnect. The interconnect is very fine, i.e. on the order of several tens to several thousands nanometers in thickness, and the protective film prevents diffusion of the interconnect material, prevents oxidation of the interconnect material, and reduces effective permittivity. In order for the film to optimally provide these protective functions for a very fine interconnect, a thickness of the film should be from 0.1 nm to 500nm, and more preferably from 10nm to 100nm.

Claims 31 and 34 have been amended to more specifically recite the semiconductor device and emphasize that the electroless-plating liquid is for forming a protective film for a very fine interconnect. In this regard, each of claims 31 and 34 now recite

A semiconductor device comprising... an interconnect... embedded in a trench in a surface of an insulating film... said trench is covered by a barrier layer... and a protective film having a thickness within a range of from 0.1nm to 500nm... covering an exposed surface of said interconnect.

New claims 43 and 47 recite a method for forming the semiconductor device, and claims 41, 42, 52 and 53 more specifically recite the thickness of the protective film that allows for optimal protection of a very fine interconnect to be achieved.

The Examiner rejected claims 24-39 under 35 U.S.C. § 102(b) as being anticipated by Mallory, Jr. and, the Examiner rejected claim 40 under 35 U.S.C. § 103(a) as being unpatentable over Mallory, Jr. These rejections are respectfully traversed in part, and Mallory, Jr. is not applicable with regard to the newly amended and added claims for the following reasons.

Mallory, Jr. pertains to a process for forming a printed wiring board or a printed circuit board. Specifically, Mallory, Jr. provides a catalytic coating on a substrate having a circuit thereon so as to render the circuit catalytic to subsequent electroless deposition of metals thereonto. Such a circuit typically has a thickness of several hundreds to several thousands micrometers. Onto this coating is plated a more durable metal than that of the circuit so as to enhance corrosion resistance and abrasion resistance of the circuit, and also to enhance the circuit's ability to be soldered and bonded to aluminum or gold wire, while at the same time maintaining or enhancing adequate conductivity. Thus, Mallory, Jr. is concerned with providing a catalyzing liquid that is to render copper catalytic to subsequent electroless deposition of a more durable metal, while at the same time improving adhesion between the copper and the metal.

The liquid of Mallory, Jr. is for forming a catalyzing coating. This is in contrast to the instant invention, wherein a **protective** film is to be formed. This distinction between the instant invention and Mallory, Jr. is believed to be clearly brought out in each of the independent claims, which recite a "protective film". Thus, because Mallory, Jr. pertains to a catalyzing coating, as opposed to a protective film, it is respectfully submitted that claims 31, 34, 43 and 47 are not anticipated by Mallory, Jr.

Additionally, each of independent claims 31, 34, 43 and 47 recites that a thickness of the protective film to be formed by the electroless-plating liquid is within a range of from 0.1nm to 500nm. As expressed previously, this specific thickness allows for the film to optimally provide its protective functions. New claims 41, 42, 52 and 53 further limit this specific thickness to be within a range of from 10nm to 100nm.

The Examiner recognized that such a thickness is not disclosed by Mallory, Jr., but took the position that such a thickness would have been obvious to one having ordinary skill in the art. Specifically, the Examiner relied upon the proposition that where the general conditions of the claims are disclosed in the prior art, discovering the optimum or working ranges involves only routine skill in the art. Applicants do not dispute the correctness of this proposition; however, it is believed to not be applicable with regard to the instant application for the following reasons.

As expressed previously, the film of the instant invention is a "protective" film, whereas the coating of Mallory, Jr. is a "catalyzing" coating. Because the instant invention pertains to a protective

film, while Mallory, Jr. pertains to a catalyzing coating, it is respectfully submitted that the general conditions of the claims are not disclosed in the prior art. The requirements of a coating to function as a catalyzing coating are different than those required for a film to function as a protective film, with one of these requirements being the thickness of the coating or the film.

Accordingly, while it may be true that in view of Mallory, Jr. one having ordinary skill in the art would have found it obvious to discover the optimum or working range of a catalyzing coating, Mallory, Jr. teaches nothing with regard to discovering the optimum or working ranges of a protective film of the instant invention. Also, there is no evidence of record to indicate that a catalyzing coating having a thickness within a range of from 0.1nm to 500nm, let alone within a range of from 10nm to 100nm, would be sufficient for the purposes of Mallory, Jr., especially in light of the differences in thickness between the interconnect of the semiconductor of the instant invention and the circuit of the printed circuit board of Mallory, Jr., i.e. the difference between several hundred nanometers and several hundred micrometers. For this additional reason, claims 31, 34, 43 and 47 are allowable over Mallory, Jr., and claims 41, 42, 52 and 53 are patentable in their own right over Mallory, Jr.

For the following reasons Mallory, Jr. does not disclose or suggest the specific semiconductor device, nor its method of manufacture, as recited in claims 31, 34, 43 and 47.

Initially, Mallory, Jr. does not disclose or suggest a semiconductor device, or a method of manufacturing a semiconductor device, having an interconnect **embedded in a trench in a surface of an insulating film**, wherein **said trench is covered by a barrier layer**, as required by claims 31, 34, 43 and 47. Accordingly, for this further reason, claims 31, 34, 43 and 47 are allowable over Mallory, Jr.

Additionally, claims 31, 34, 43 and 47 also recite that the protective film is formed by using an electroless-plating liquid **without using palladium**. The significance of not using palladium, is that palladium is a catalyst which when substituted for interconnects of copper, creates voids in the interconnects. These voids adversely lower reliability of the interconnects. According to the instant invention, because palladium is not required to form the protective film by electroless-plating, voids are prevented from being produced in the interconnects, and therefor, the present invention enhances reliability of the interconnects.

To the contrary, in Mallory, Jr., a catalyst layer is applied to a printed circuit board, and thus, for this additional reason claims 31, 34, 43 and 47 are allowable over Mallory, Jr.

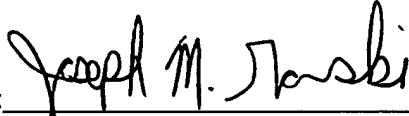
Thus, claims 31-37 and 41-53 are allowable.

In view of the above amendments and remarks, it is respectfully submitted that the present application is in condition for allowance and an early Notice of Allowance is earnestly solicited.

If after reviewing this Amendment, the Examiner believes that any issues remain which must be resolved before the application can be passed to issue, the Examiner is invited to contact the Applicants' undersigned representative by telephone to resolve such issues.

Respectfully submitted,

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